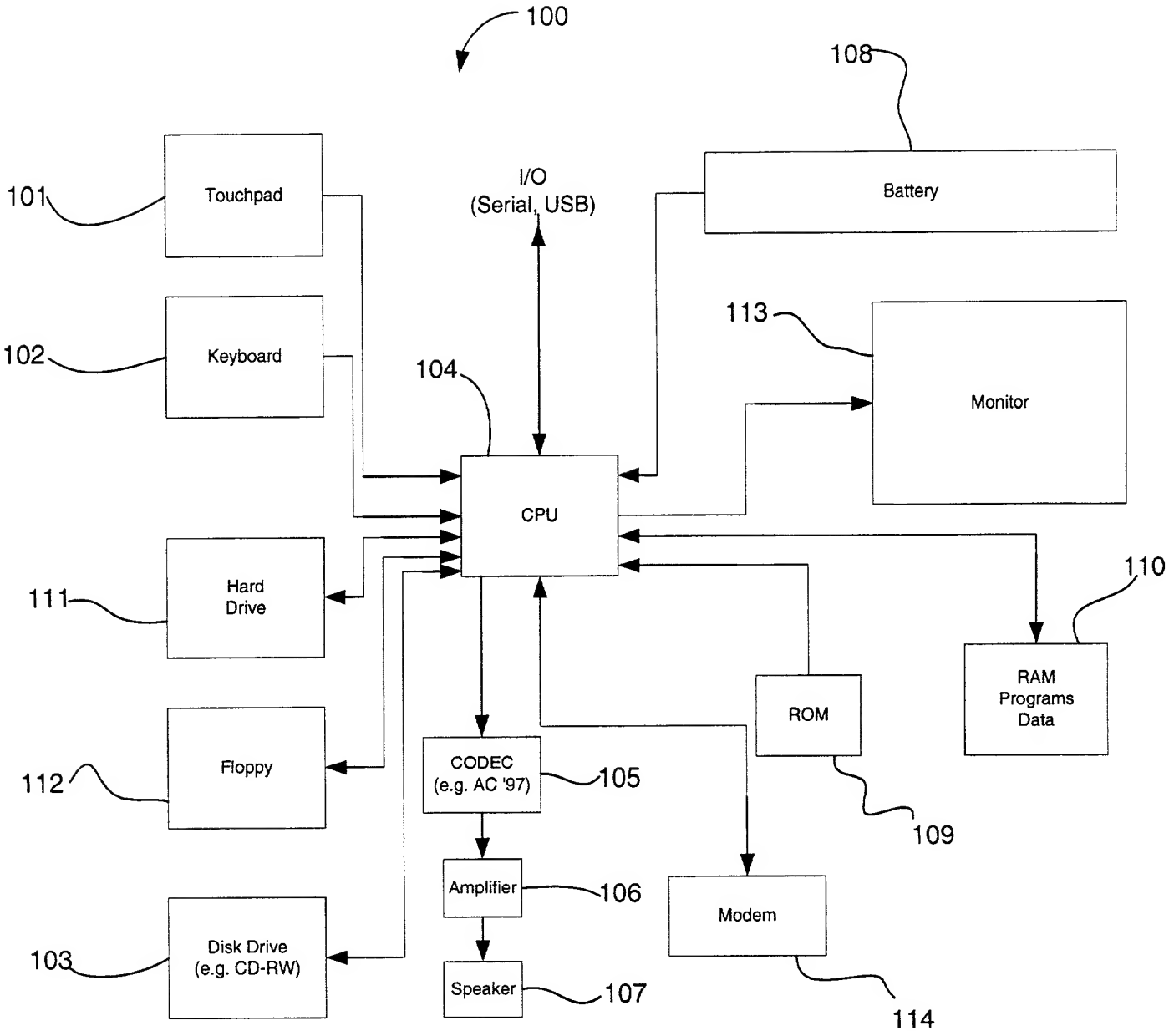

100
108
Battery
101
Touchpad
I/O
(Serial, USB)
102
Keyboard
104
113
Monitor
CPU
111
Hard
Drive
110
RAM
Programs
Data
ROM
112
Floppy
CODEC
(e.g. AC '97)
105
109
Amplifier
106
Modem
103
Disk Drive
(e.g. CD-RW)
Speaker
107
114

Fig. 1

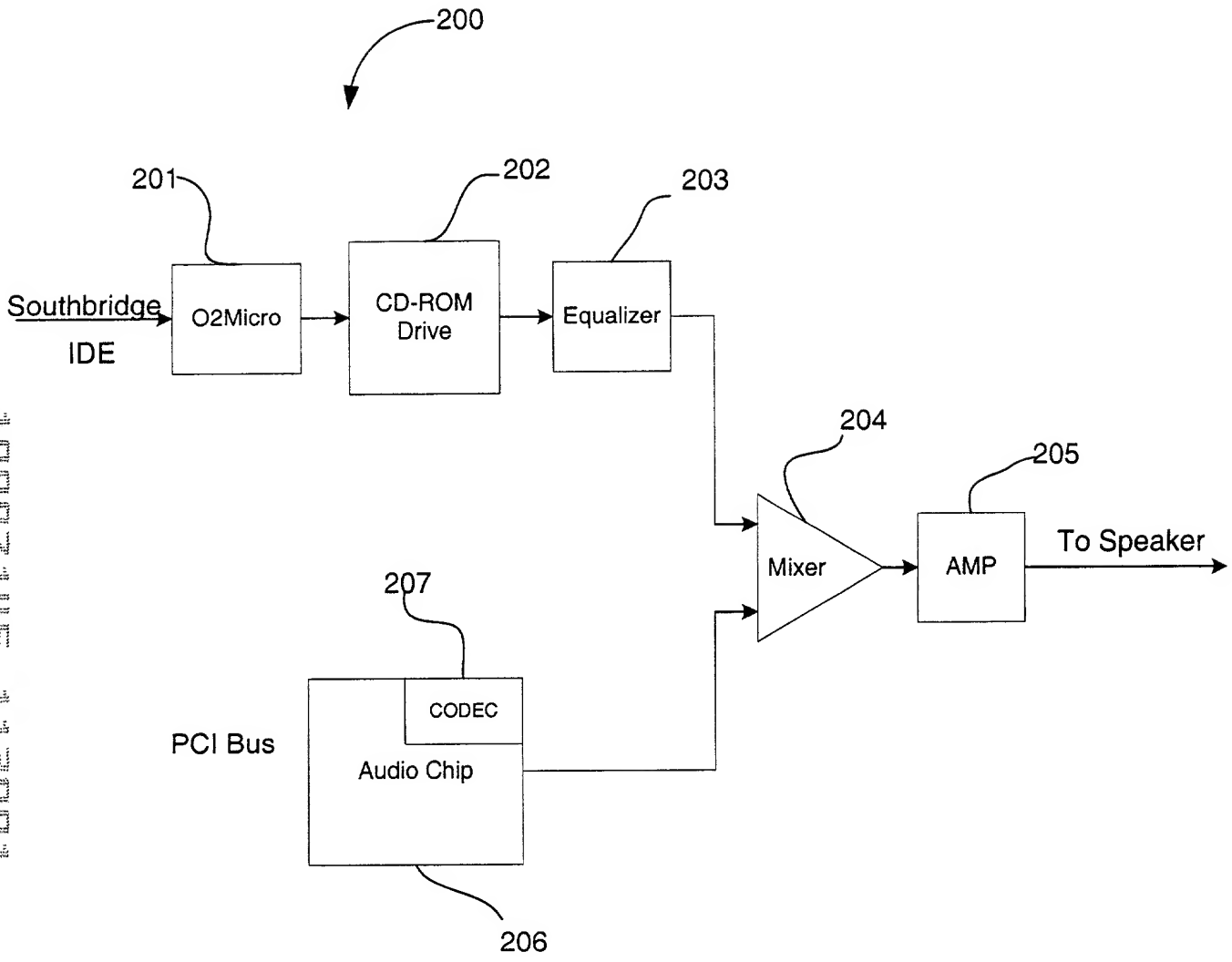

200
201
202
203
Southbridge
IDE
O2Micro
CD-ROM
Drive
Equalizer
204
205
Mixer
AMP
To Speaker
207
CODEC
PCI Bus
Audio Chip
206

Fig. 2

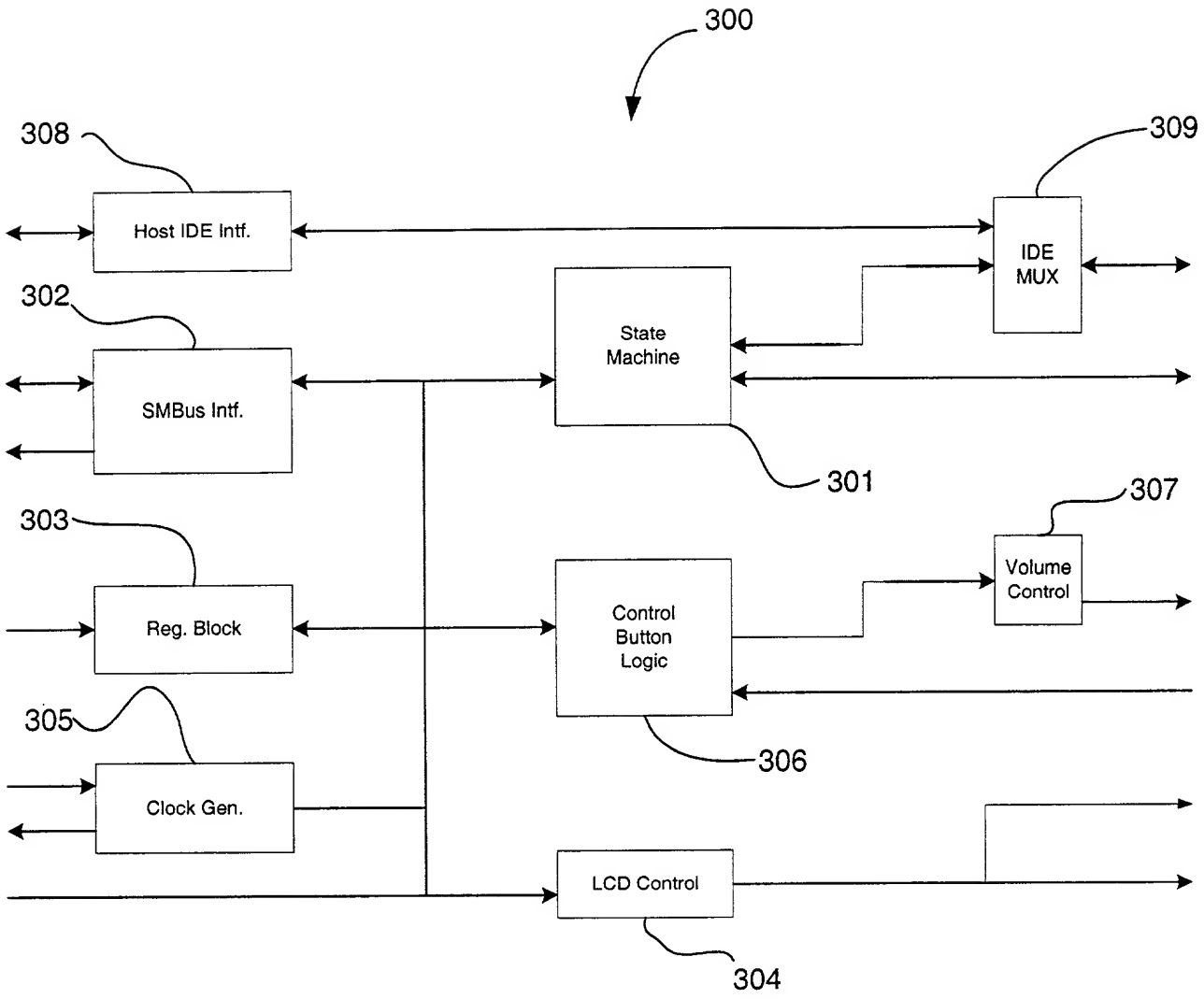

300
308
Host IDE Intf.
309
IDE
MUX
302
SMBus Intf.
State
Machine
301
303
Reg. Block
307
Volume
Control
Control
Button
Logic
306
305
Clock Gen.
LCD Control
304

Fig. 3

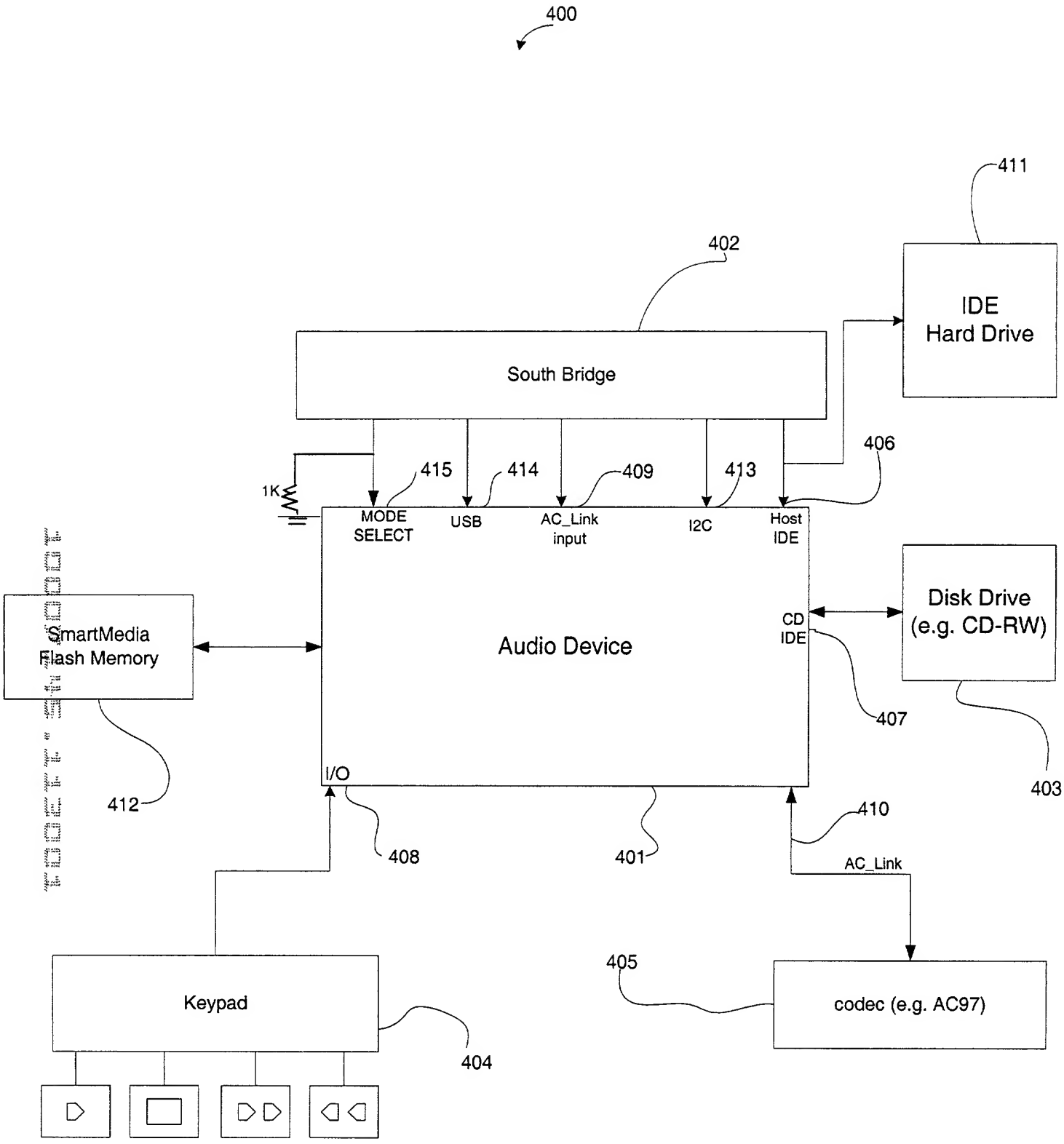

400
411
402
IDE
Hard Drive
South Bridge
406
1K
415
414
409
413
MODE
SELECT
USB
AC_Link
input
I2C
Host
IDE
SmartMedia
Flash Memory
Audio Device
CD
IDE
Disk Drive
(e.g. CD-RW)
407
412
403
I/O
410
408
401
AC_Link
405
Keypad
codec (e.g. AC97)
404

Fig. 4

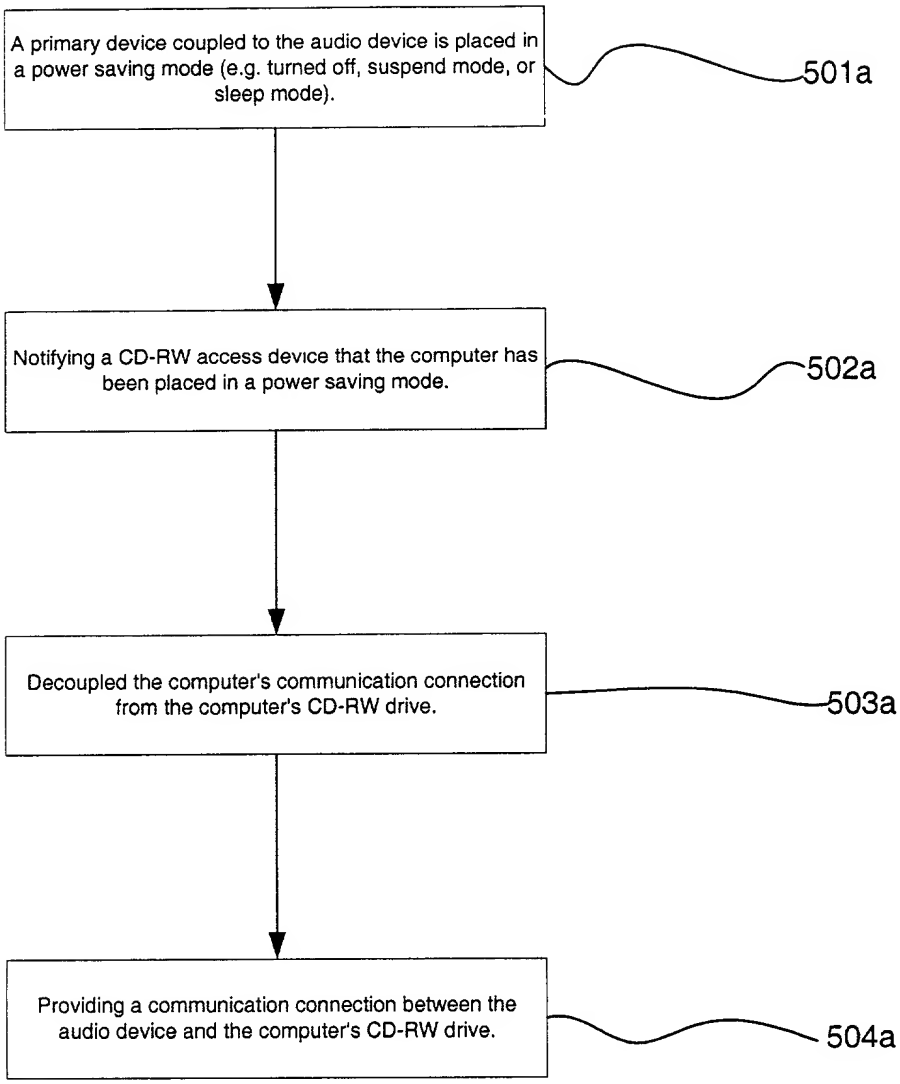

A primary device coupled to the audio device is placed in a power saving mode (e.g. turned off, suspend mode, or sleep mode).
501a
Notifying a CD-RW access device that the computer has been placed in a power saving mode.
502a
Decoupled the computer's communication connection from the computer's CD-RW drive.
503a
Providing a communication connection between the audio device and the computer's CD-RW drive.
504a

Fig. 5a

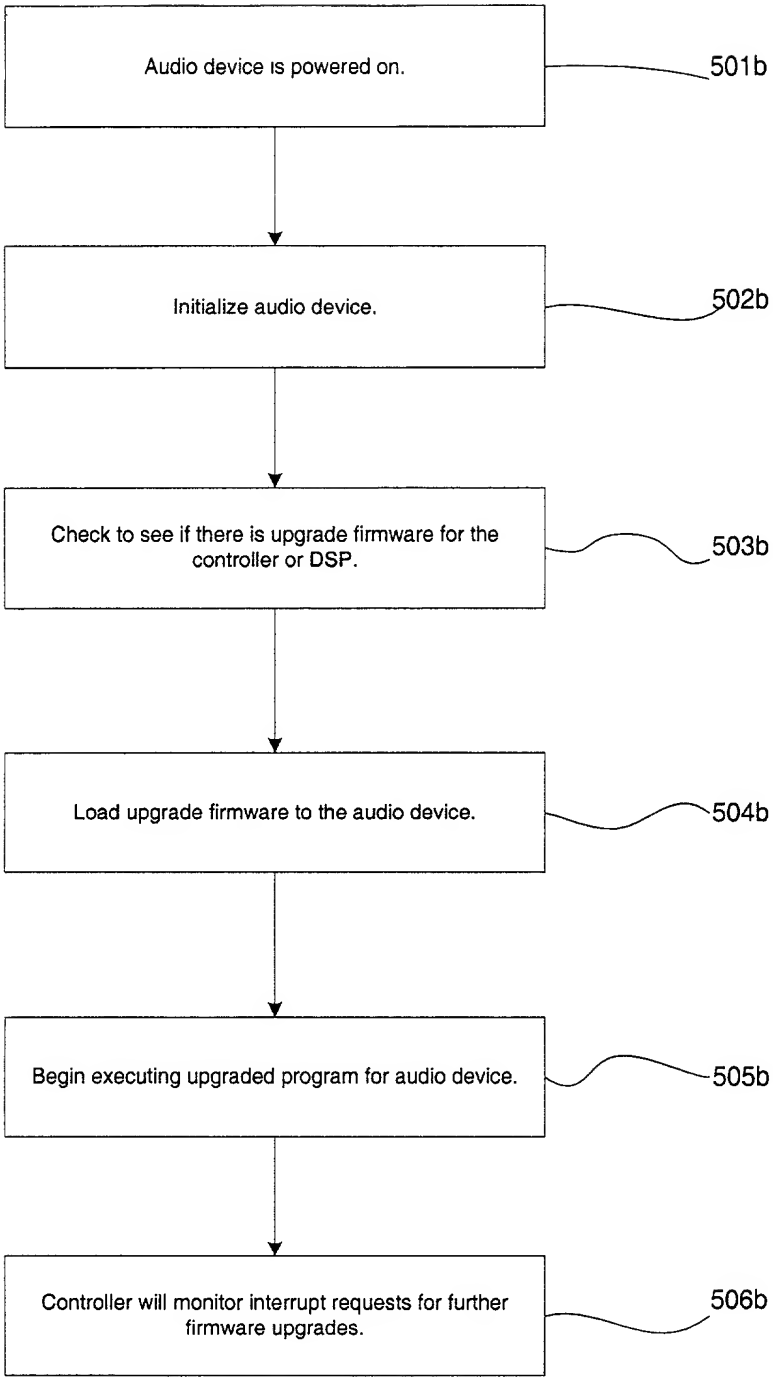

Audio device is powered on.
501b
Initialize audio device.
502b
Check to see if there is upgrade firmware for the controller or DSP.
503b
Load upgrade firmware to the audio device.
504b
Begin executing upgraded program for audio device.
505b
Controller will monitor interrupt requests for further firmware upgrades.
506b

Fig. 5b

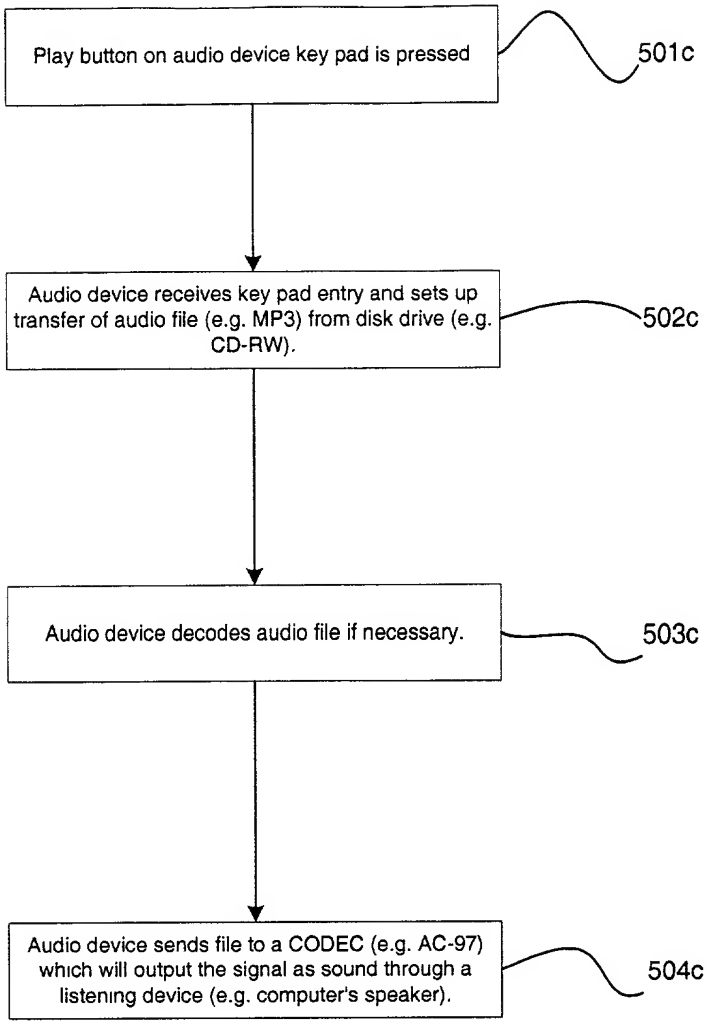

Play button on audio device key pad is pressed
501c
Audio device receives key pad entry and sets up transfer of audio file (e.g. MP3) from disk drive (e.g. CD-RW).
502c
Audio device decodes audio file if necessary.
503c
Audio device sends file to a CODEC (e.g. AC-97) which will output the signal as sound through a listening device (e.g. computer's speaker).
504c

Fig. 5c

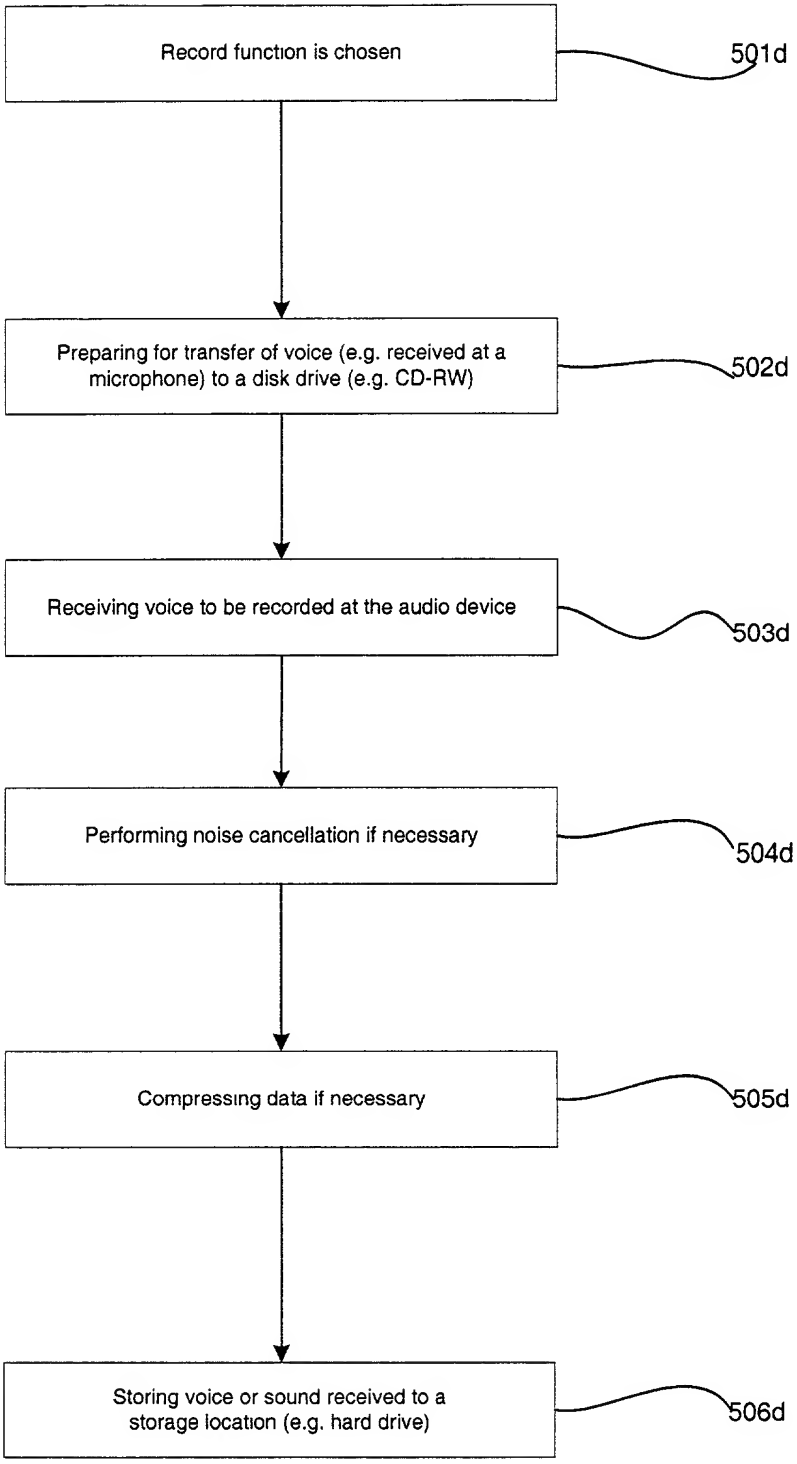

Record function is chosen
501d
Preparing for transfer of voice (e.g. received at a microphone) to a disk drive (e.g. CD-RW)
502d
Receiving voice to be recorded at the audio device
503d
Performing noise cancellation if necessary
504d
Compressing data if necessary
505d
Storing voice or sound received to a storage location (e.g. hard drive)
506d

Fig. 5d

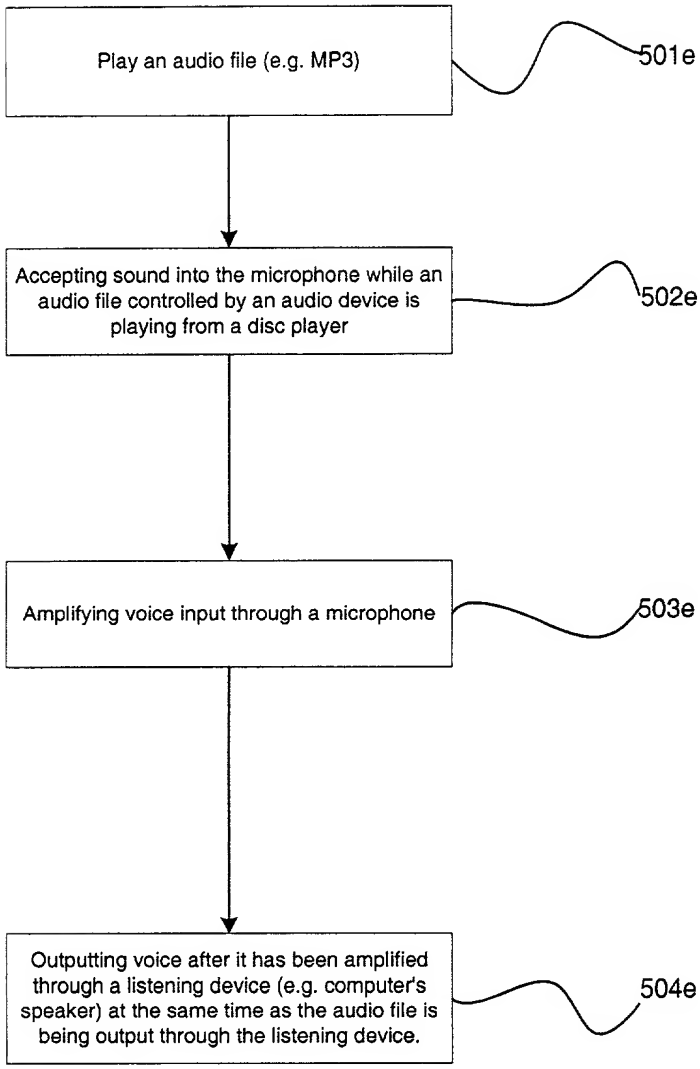

Play an audio file (e.g. MP3)
501e
Accepting sound into the microphone while an audio file controlled by an audio device is playing from a disc player
502e
Amplifying voice input through a microphone
503e
Outputting voice after it has been amplified through a listening device (e.g. computer's speaker) at the same time as the audio file is being output through the listening device.
504e

Fig. 5e

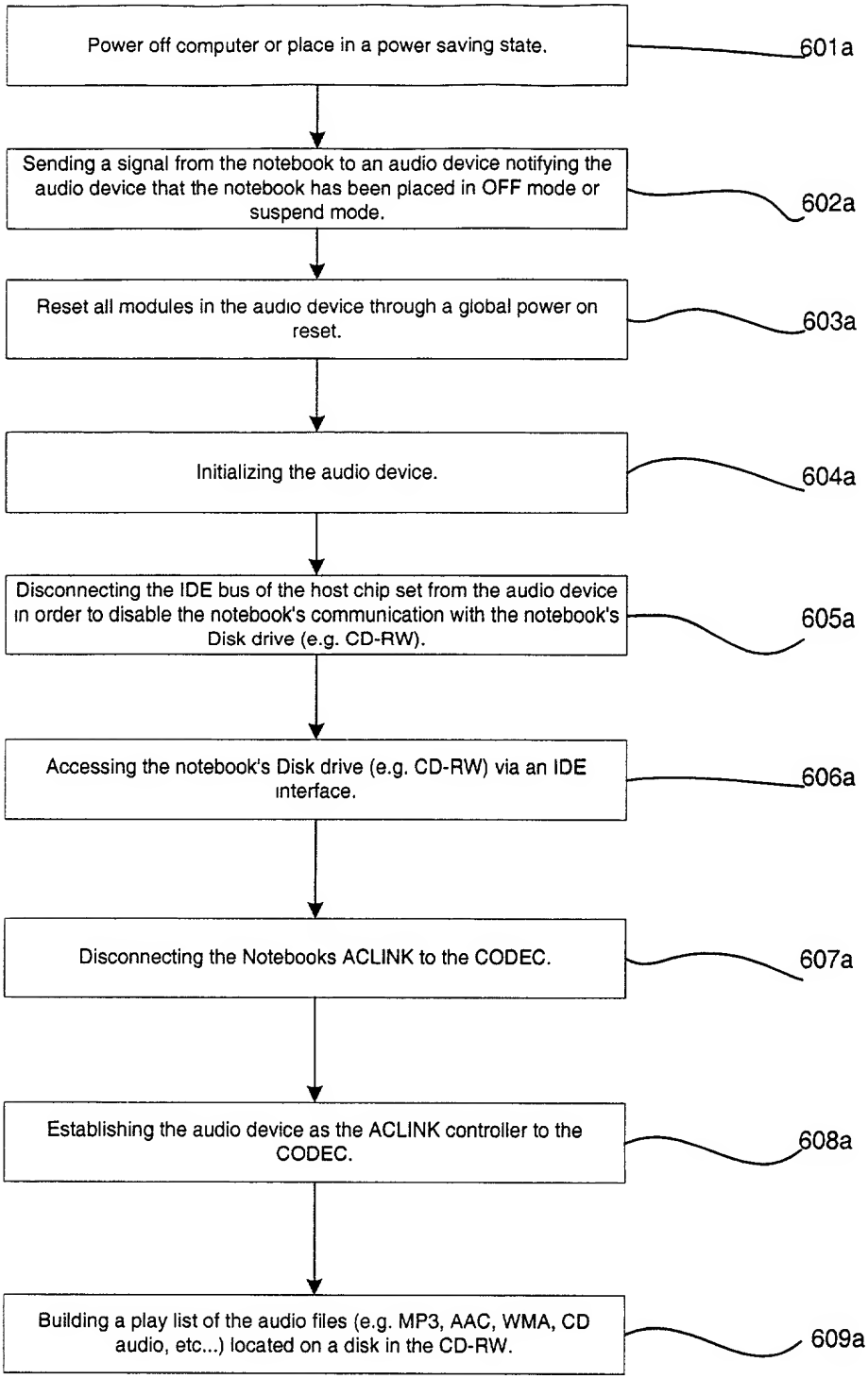

Power off computer or place in a power saving state.
601a
Sending a signal from the notebook to an audio device notifying the audio device that the notebook has been placed in OFF mode or suspend mode.
602a
Reset all modules in the audio device through a global power on reset.
603a
Initializing the audio device.
604a
Disconnecting the IDE bus of the host chip set from the audio device in order to disable the notebook's communication with the notebook's Disk drive (e.g. CD-RW).
605a
Accessing the notebook's Disk drive (e.g. CD-RW) via an IDE interface.
606a
Disconnecting the Notebooks ACLINK to the CODEC.
607a
Establishing the audio device as the ACLINK controller to the CODEC.
608a
Building a play list of the audio files (e.g. MP3, AAC, WMA, CD audio, etc...) located on a disk in the CD-RW.
609a

Fig. 6a

TEST	MODE_SELECT	MODE	
0	1	Transparent Mode	601b
0	0	DSP Mode	602b
1	0	Scan Mode	603b
1	1	Test Mode	604b

Figure 6b

700a

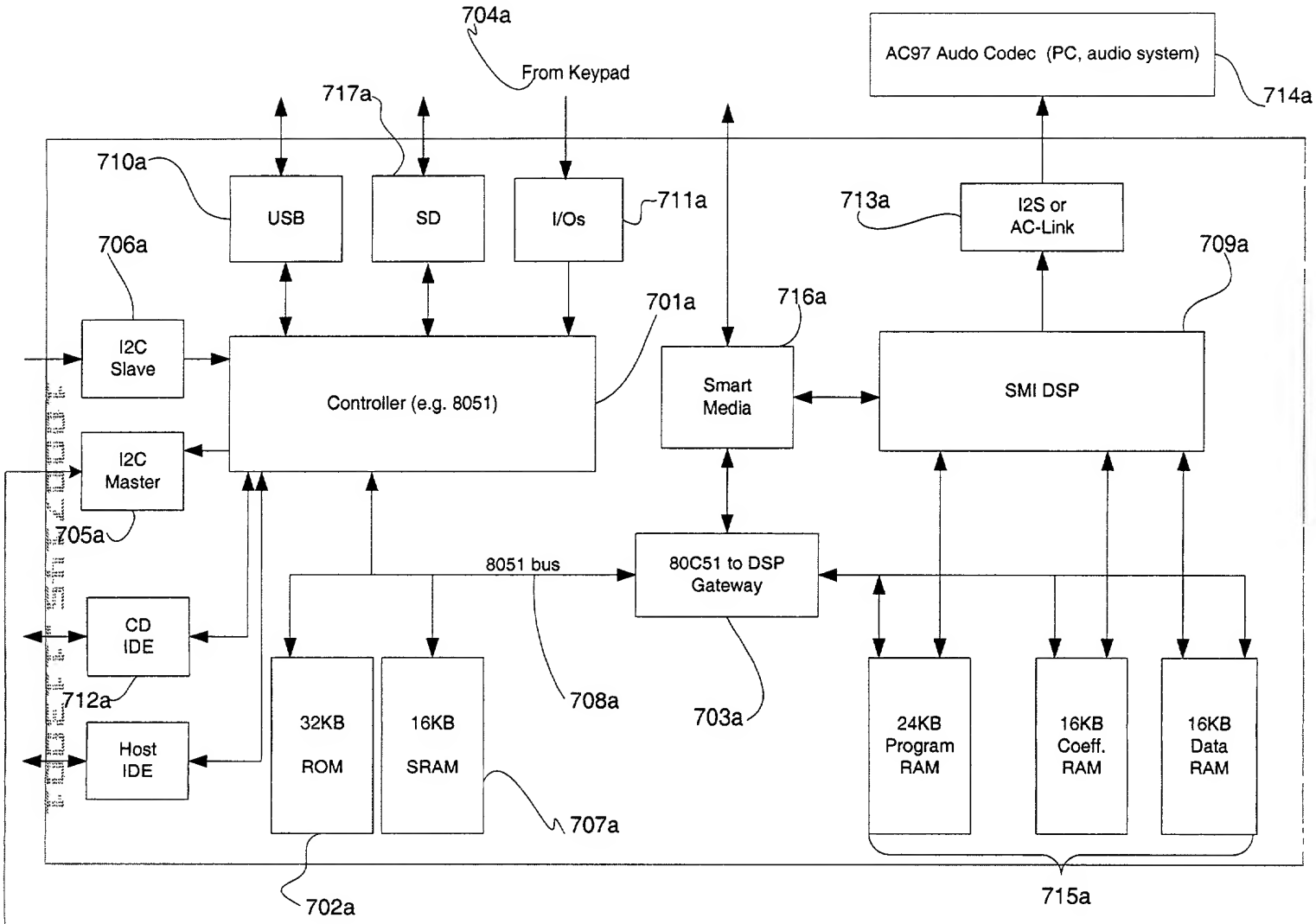
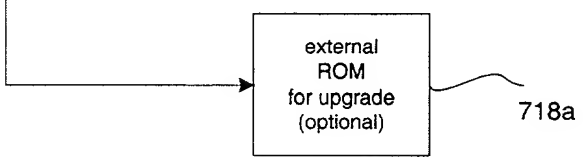

704a
From Keypad
717a
AC97 Audo Codec (PC, audio system)
714a
710a
USB
SD
I/Os
711a
713a
I2S or
AC-Link
706a
709a
701a
716a
I2C
Slave
Controller (e.g. 8051)
Smart
Media
SMI DSP
I2C
Master
705a
8051 bus
80C51 to DSP
Gateway
CD
IDE
712a
708a
703a
32KB
ROM
16KB
SRAM
24KB
Program
RAM
16KB
Coeff.
RAM
16KB
Data
RAM
Host
IDE
707a
702a
715a

Fig. 7a


external
ROM
for upgrade
(optional)
718a

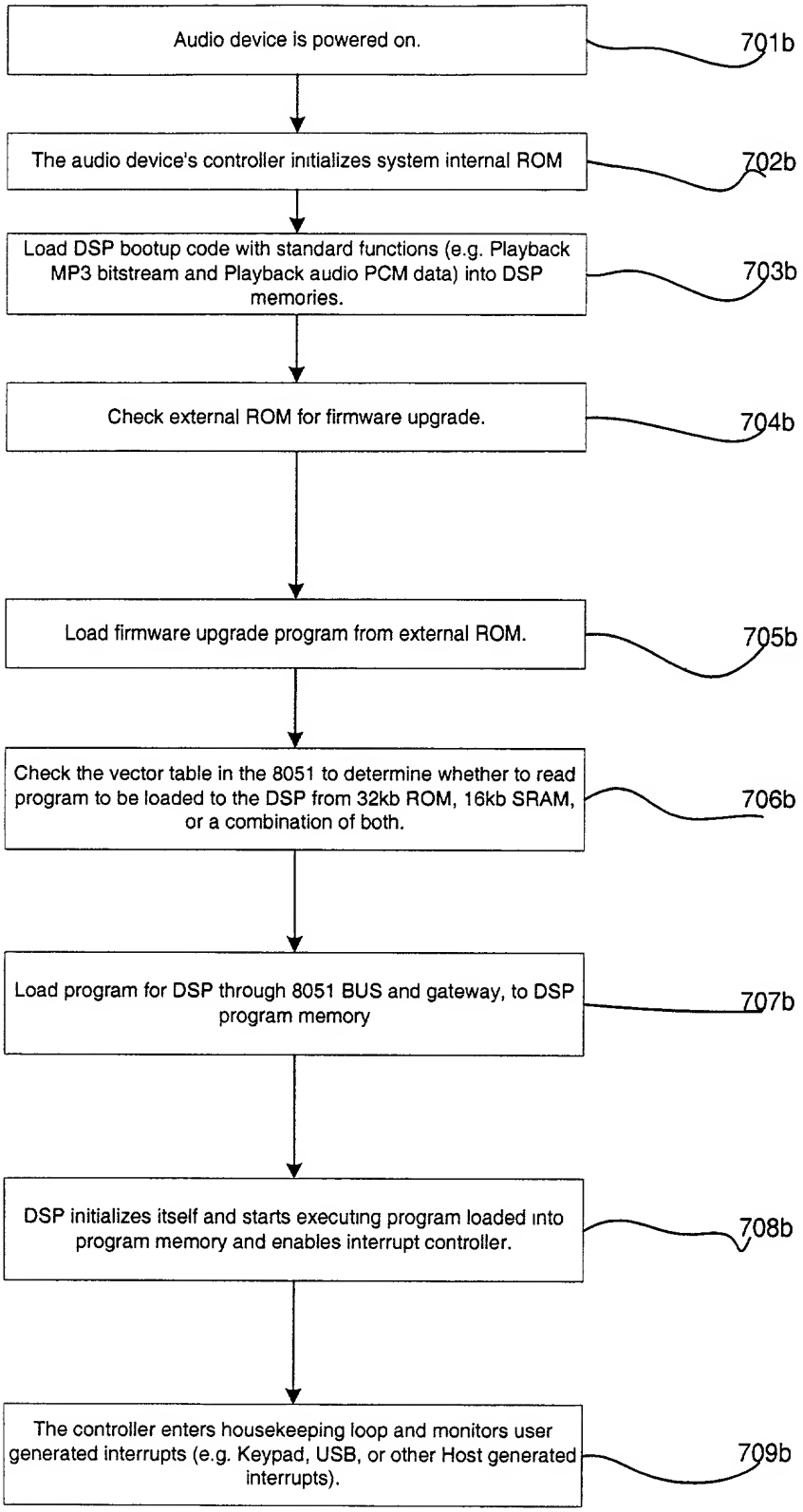

Audio device is powered on.
701b
The audio device's controller initializes system internal ROM
702b
Load DSP bootup code with standard functions (e.g. Playback MP3 bitstream and Playback audio PCM data) into DSP memories.
703b
Check external ROM for firmware upgrade.
704b
Load firmware upgrade program from external ROM.
705b
Check the vector table in the 8051 to determine whether to read program to be loaded to the DSP from 32kb ROM, 16kb SRAM, or a combination of both.
706b
Load program for DSP through 8051 BUS and gateway, to DSP program memory
707b
DSP initializes itself and starts executing program loaded into program memory and enables interrupt controller.
708b
The controller enters housekeeping loop and monitors user generated interrupts (e.g. Keypad, USB, or other Host generated interrupts).
709b

Fig. 7b

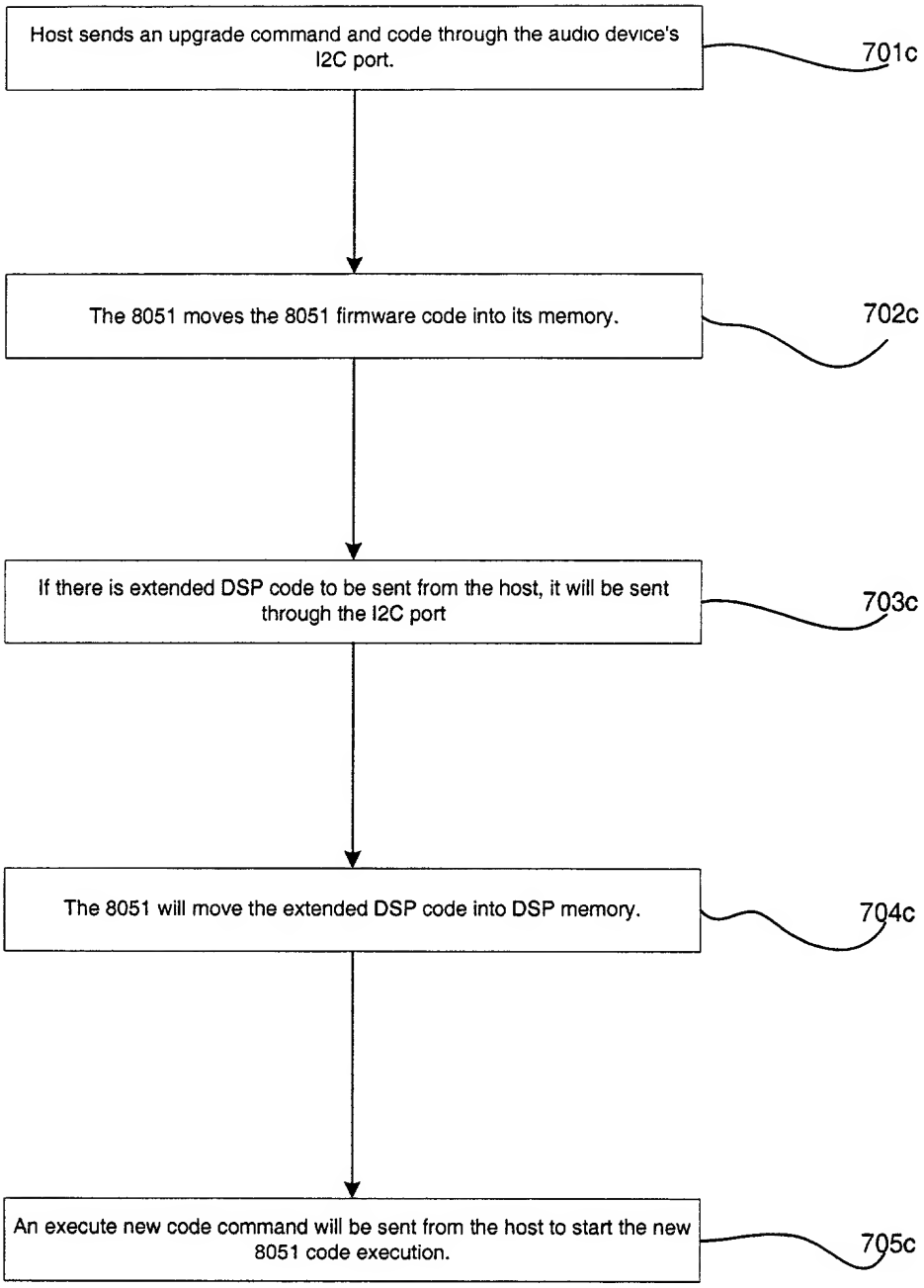

Host sends an upgrade command and code through the audio device's I2C port.
701c
The 8051 moves the 8051 firmware code into its memory.
702c
If there is extended DSP code to be sent from the host, it will be sent through the I2C port
703c
The 8051 will move the extended DSP code into DSP memory.
704c
An execute new code command will be sent from the host to start the new 8051 code execution.
705c

Figure 7c

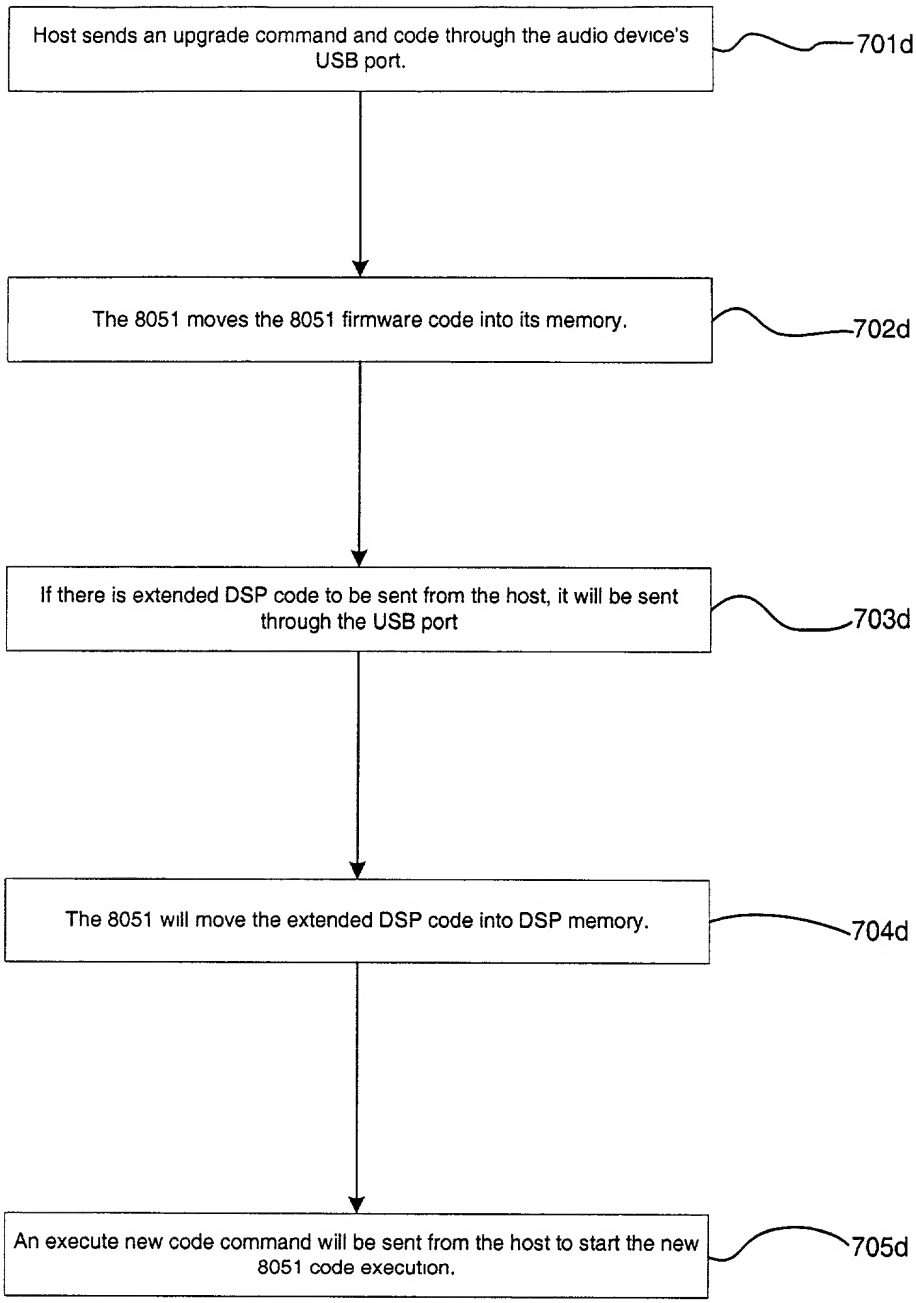

Host sends an upgrade command and code through the audio device's USB port.
701d
The 8051 moves the 8051 firmware code into its memory.
702d
If there is extended DSP code to be sent from the host, it will be sent through the USB port
703d
The 8051 will move the extended DSP code into DSP memory.
704d
An execute new code command will be sent from the host to start the new 8051 code execution.
705d

Figure 7d

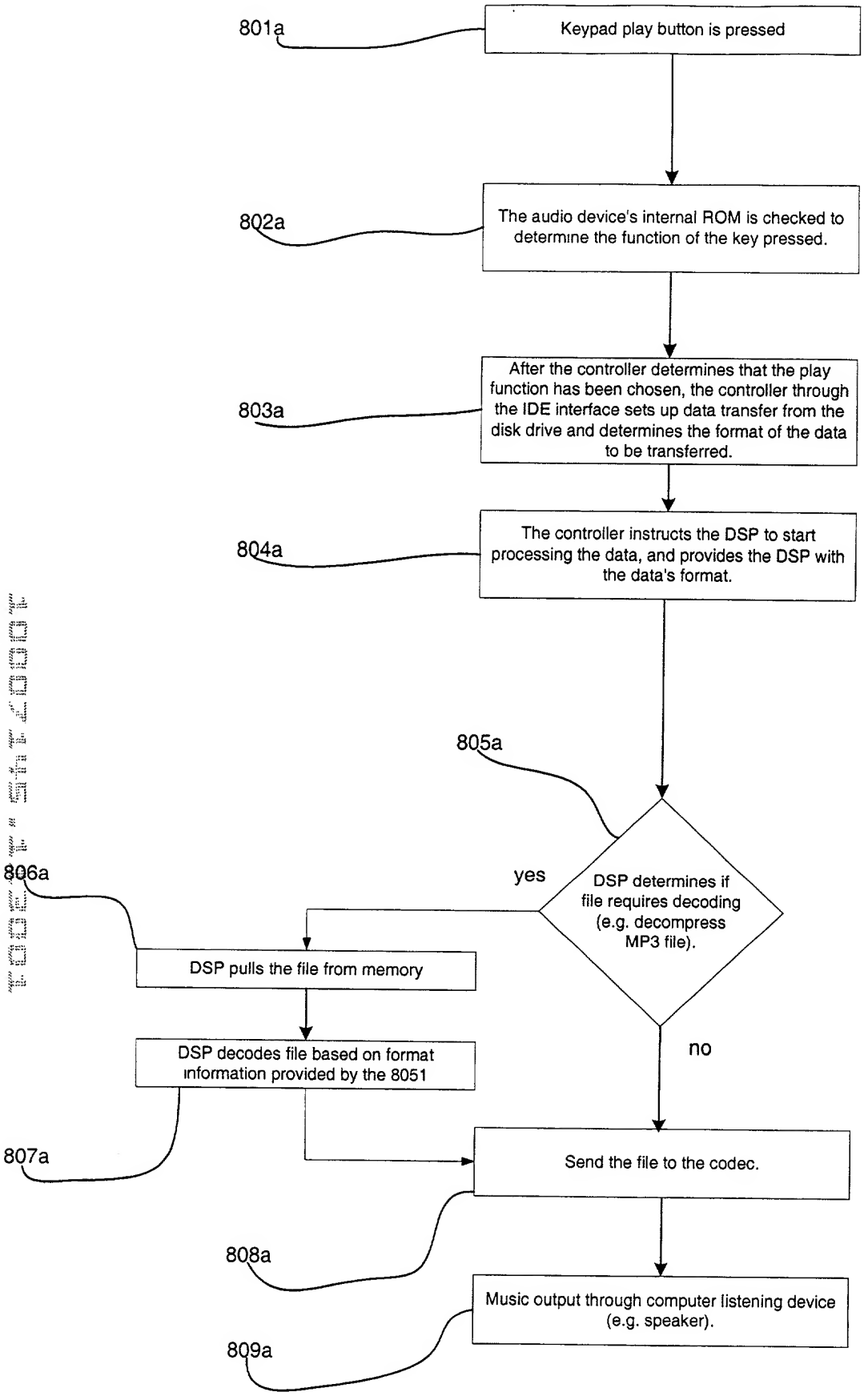

801a
Keypad play button is pressed
802a
The audio device's internal ROM is checked to determine the function of the key pressed.
803a
After the controller determines that the play function has been chosen, the controller through the IDE interface sets up data transfer from the disk drive and determines the format of the data to be transferred.
804a
The controller instructs the DSP to start processing the data, and provides the DSP with the data's format.
805a
DSP determines if file requires decoding (e.g. decompress MP3 file).
yes
no
806a
DSP pulls the file from memory
DSP decodes file based on format information provided by the 8051
807a
Send the file to the codec.
808a
Music output through computer listening device (e.g. speaker).
809a

Figure 8a

801b

Audio Device pin name	Audio Device pin #	Function
Key0	64	Back plays the previous song on the play list
Key1	65	Skip jumps to the next song on the play list
Key2	66	Play/Pause toggles between Play and Pause
Key3	67	Stop/Eject/Load toggles between Stop, Eject and Load
Key4	68	Volume Down decreases the volume
Key5	69	Volume up increases the volume
Key6	70	Mute volume
Key7	71	Lock. Once this key is pressed, all the other keys (0-6) are inactive

Figure **8b**

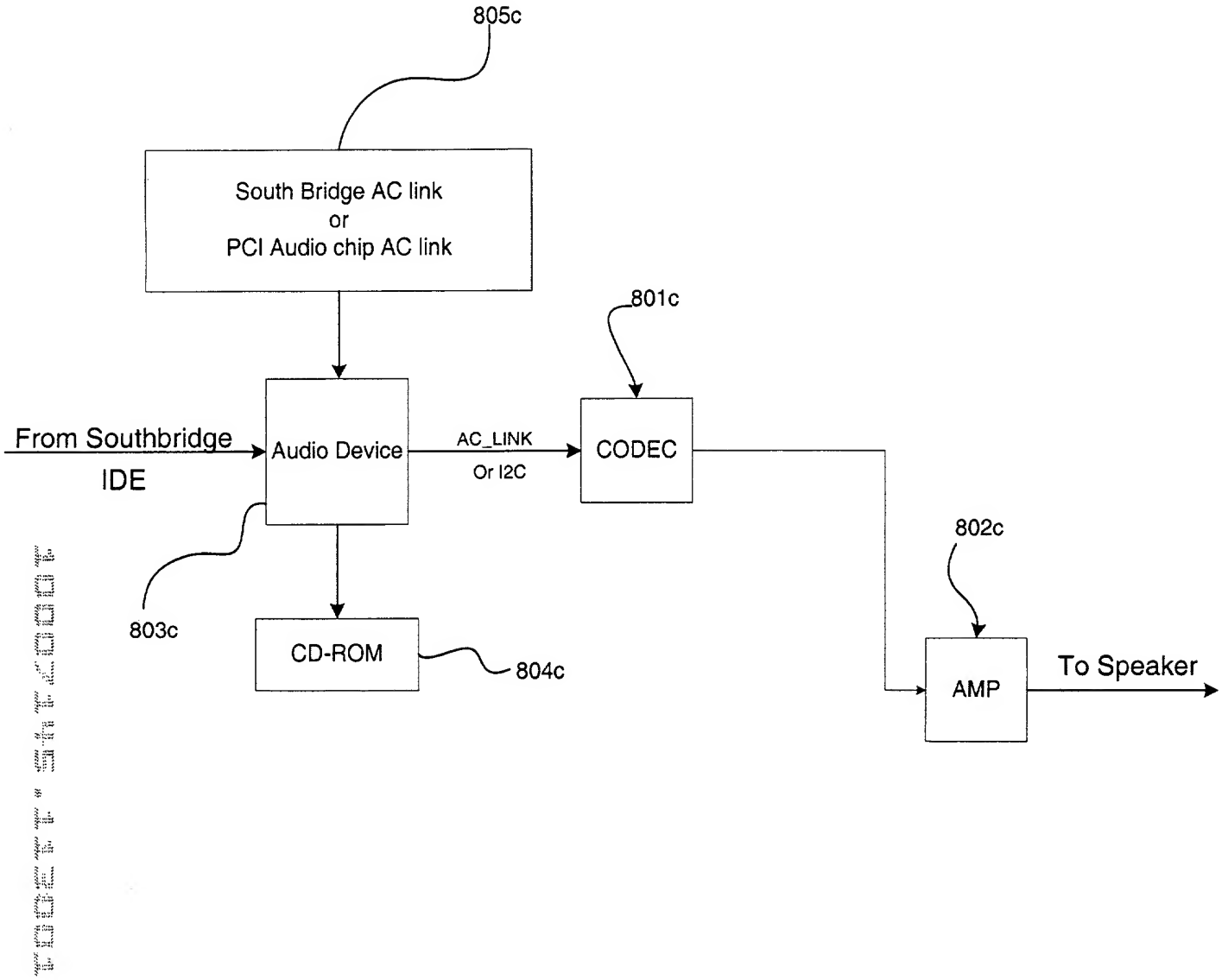

805c
South Bridge AC link
or
PCI Audio chip AC link
801c
From Southbridge
IDE
Audio Device
AC_LINK
Or I2C
CODEC
802c
803c
CD-ROM
804c
AMP
To Speaker

Figure 8c

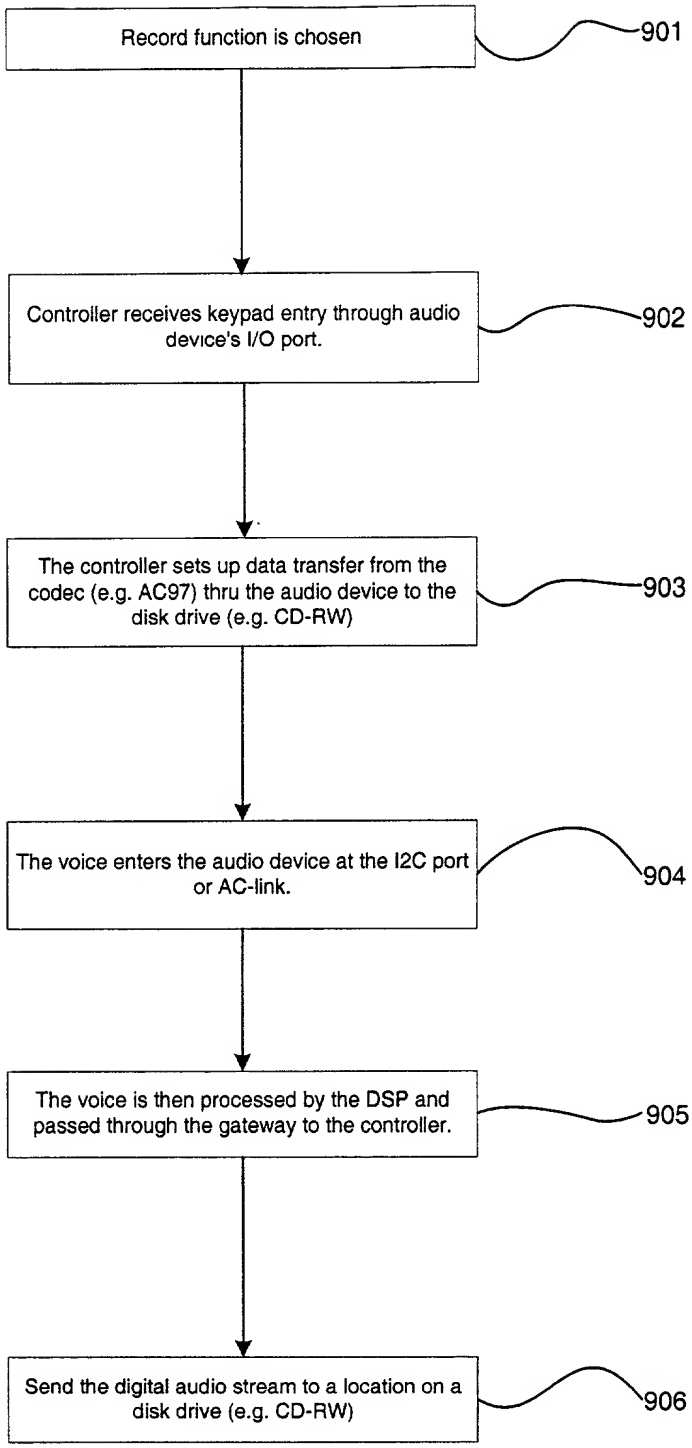

Record function is chosen
901
Controller receives keypad entry through audio device's I/O port.
902
The controller sets up data transfer from the codec (e.g. AC97) thru the audio device to the disk drive (e.g. CD-RW)
903
The voice enters the audio device at the I2C port or AC-link.
904
The voice is then processed by the DSP and passed through the gateway to the controller.
905
Send the digital audio stream to a location on a disk drive (e.g. CD-RW)
906

Fig. 9

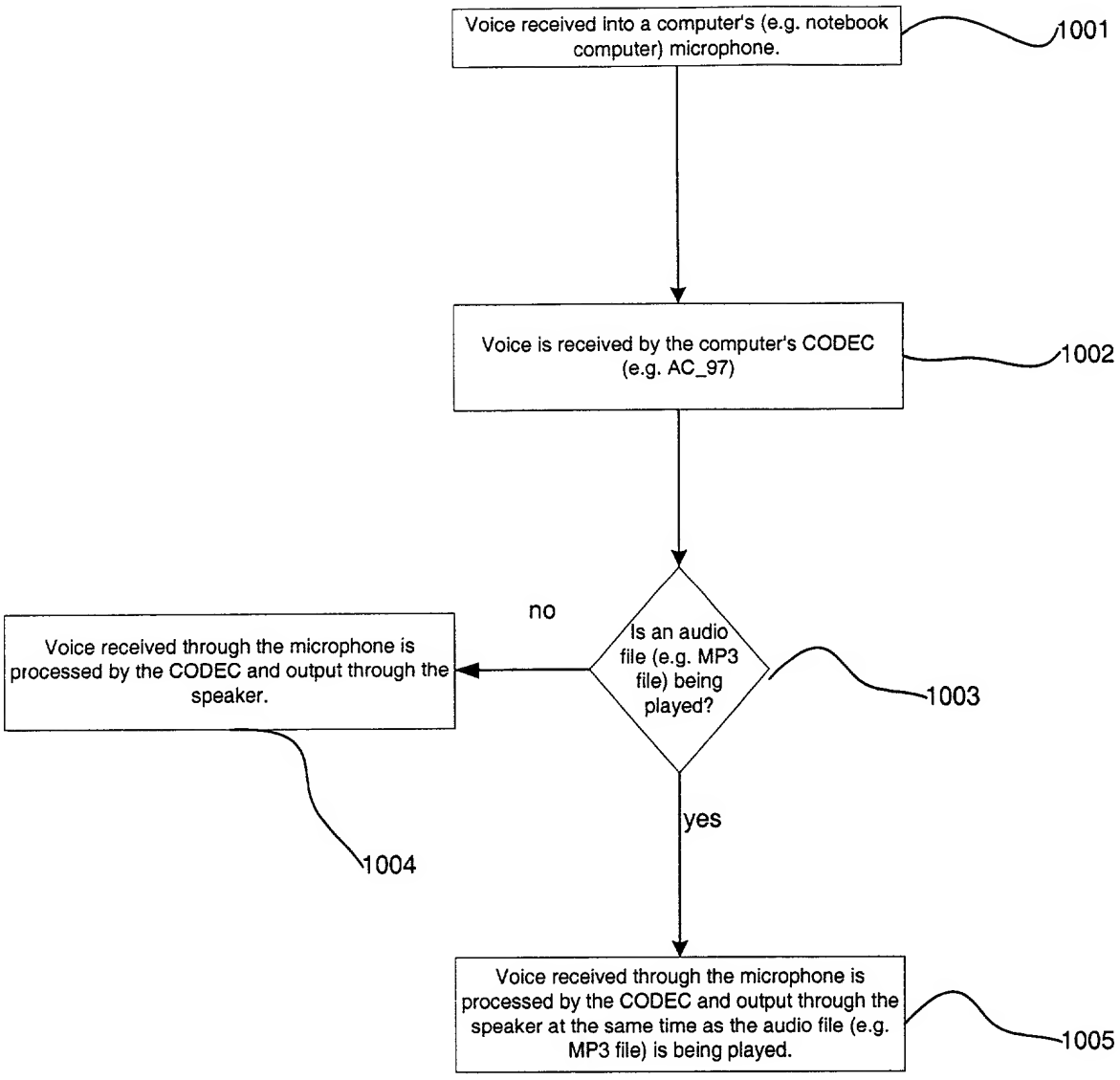

Voice received into a computer's (e.g. notebook computer) microphone.
1001
Voice is received by the computer's CODEC (e.g. AC_97)
1002
Is an audio file (e.g. MP3 file) being played?
1003
no
Voice received through the microphone is processed by the CODEC and output through the speaker.
1004
yes
Voice received through the microphone is processed by the CODEC and output through the speaker at the same time as the audio file (e.g. MP3 file) is being played.
1005

Fig. 10